terial science goes, that there is no specific osteomyelitic micro-organism other than those found in a number of other inflammatory processes connected with suppuration, viz., the *staphylococcus pyogenes.*

In order to satisfy himself that the micro-organisms of osteomyelitis possessed the same action as those other ones found in phlegmons, the author inoculated himself with pure cultures obtained from his osteomyelitis cases. Twice he introduced small quantities of culture-gelatine into cuts made for the purpose in his finger, and also applied a large quantity to the healthy skin of his arm by inunction. The first experiments resulted in slight phlegmonous inflammations; the latter procedure, however, caused a large and painful carbuncle of three weeks' duration. In these experiments, too, the pus again yielded pure cultures of the original form of micrococcus, *staph. pyog. aur*

More recently Passet has succeeded in differentiating three distinct varieties of the *staphylococcus*, which differ mainly in the color of the colonies, and which he terms respectively, *aureus*, *albus* and *citreus.* But whether the latter is present in the pus formed in acute osteomyelitis has not yet been investigated. W. W. VANARSDALE.

ON TRANSFUSION AND REINFUSION OF BLOOD.

The recent practical communication by Dr. John Duncan, of Edinburgh, in the British Medical Journal, of Jan. 30, 1886, on the subject of Reinfusion of Blood in Primary and other Amputations, is deserving of careful consideration. Notwithstanding the positive statements of some (Bergmann, 1883; Mikulicz, 1884) that all that can be effected by the operation of transfusion of blood can be accomplished by the simpler means of infusing into the veins a solution of common salt, upon the hypothesis that what was required was to fill the elastic tubes of the vascular system with a certain amount of fluid. not necessarily blood, nevertheless the experience of many observers accords with the opinion expressed by Duncan, that the benefit from these saline injections is but temporary. For a time the conclusions of Köhler as to the dangers of ferment intoxication resulting from transfusions of defibrinated blood, strongly indorsed by Bergmann, have nevertheless

tended to popularize the use of saline infusions. Said the latter surgeon in an address at the opening of the Academy of Military Surgery (Berlin, 1883):

"When defibrinated blood is transfused, the fibrino-plastic element and the fibrine ferment find themselves free, and in this state they tend to cause coagulation of the moving contents of the blood-vessels. To some extent the organism protects itself against this tendency to coagulation, and within certain limits is able to resist its effects, but if the quantity of the injected fluid be great, coagulation will take place. Köhler's experiments have proved still more. Everything which destroys the blood corpuscles in the blood-vessels and sets their contents free produces a vital ferment in the blood. This causes two things: first, extensive further dissolution and decomposition of the blood corpuscles and coagulation of the blood; and, second, smaller disturbances—a certain amount of disorganization of the blood—with which, however, the organism can still go on, and which it may overcome, but only amidst symptoms of a definite form of illness, those complex symptoms which Magendie has described as typical of transfusion with defibrinated blood, which Panum describes as typical of foreign blood, and which Köhler calls 'ferment-intoxication.' "

Heineke (1885) however, declares that, "although transfusion with some kinds of defibrinated blood may induce 'ferment-intoxication,' yet it only occurs in rare cases under exceptional circumstances, and that careful transfusion with defibrinated human blood may be considered upon the whole as free from danger, provided not too large an amount of blood is injected at one time—at most not more than from 150 to 200 grams." The present proposition, and already many times repeated practice of Duncan, is to use neither saline solution nor defibrinated blood, but fresh blood, whose coagulation is retarded by the admixture of a certain proportion of phosphate of soda. In cases of primary amputations for injury, and in the major amputations for disease performed upon wasted and anæmic patients, he catches the blood unavoidably lost and reinjects it into the vascular system of the patient through the main vein which is exposed upon the surface of the stump. In such cases, one of them an amputation at the hip, he réports that he has already done this in a sufficient number of in-

stances to enable him to speak with confidence as to the safety and value of the procedure. The idea, he states, occurred to him in the course of considerable experience in ordinary transfusion. A colleague having had under his care a case of pernicious anæmia, in which the decadence was so rapid that the end could not be postponed many weeks, and having come to the conclusion that it would be right to try transfusion of blood, consulted him on the subject. Having himself tried, or seen tried by others, most of the instruments hitherto in use for direct transfusion, he had arrived at the opinion that all were unsatisfactory, either from the risk attending them, or from liability to failure in attaining the desired end. It appeared to him, therefore, that it was necessary to adopt the method of defibrination, or to delay the coagulation of the blood by some of the saline additions which have already been used for the purpose, in order that a sufficient quantity might be injected with sufficient slowness.

In making inquiry as to the experience of others, he was informed by his colleague, Dr. Cotterill, that he had on one occasion performed transfusion of blood mingled with phosphate of soda, as recommended by Dr. Pavy, and that the immediate result of the operation had been all that could be desired. As the power of phosphate of soda to delay coagulation is undoubted, he determined to adopt a plan whose feasibility was thus assured.

Without going into the history of the pernicious anæmia, it suffices to say that, by four transfusions, the quantity of the red corpuscles and hæmoglobin was trebled, and that the improvement has been maintained for two months without further operation.

In another instance he had operated in a case of empyema by resection of portions of seven ribs. A certain amount of blood was unavoidably lost during the operation, and through the night slow oozing took place into the thoracic cavity, making little show outside the dressings. Next day the patient seemed moribund; and, in the absence of the operator, his house surgeon, Dr. Carmichael, had himself bled to six ounces, and injected that quantity with phosphate solution into the patient's veins. The man immediately rallied, and is now quite well.

An operation of this kind plainly requires attention to detail, but its

extreme simplicity renders easy the avoidance of mistakes. Much importance is to be attached to the perfect fluidity of the blood, and the aseptic condition of all the instruments. In no case had any patient the slightest fever, rigor, or disturbance of any sort subsequent to the operation. Glass was purified by prolonged immersion in a solution of bichloride of mercury, metal in carbolic acid.

For introduction into the vein of the receiver, a short glass-tube, of the size of a No. 6 catheter, having a pen-shaped point, was used. To its other end, made slightly bulbous, about two inches of India-rubber tubing is attached. A simple glass syringe, holding four ounces, whose nozzle fits the tubing, is perfectly effective. The temperature may be kept up by surrounding it with boric lint, wrung out of hot water. A graduated glass vessel, kept floating in warm water, contains the solution of phosphate of soda, and receives the blood.

All are washed with aseptic water after removal from the antiseptic solution, and before being used.

In amputations, the most convenient vein is selected on the face of the stump, the glass point is inserted, and a catgut ligature put round it. While the process of ligaturing the arteries is going on, the blood is caught by one assistant, who adds the soda-solution as required, and is slowly injected by another. There is no time wasted, and the amount put into the circulation is precisely proportioned to what the patient would otherwise have lost, *plus* what amount of saline solution the surgeon may think right and appropriate to the case.

In the case of pernicious anæmia to which reference has been made, a vein in the arm of the blood-receiver was exposed, and under it a double thread of catgut was passed. The blood was then drawn from the donor into the dish containing the phosphate of soda, with which it was gently mixed by means of a glass rod. While an assistant filled the syringe, the exposed vein of the receiver was opened, the lower thread of catgut being gently pulled upon to prevent bleeding. The tube was then inserted, the upper thread tied round it with one knot, and the lower definitely secured and cut short. The blood was next slowly injected, the India-rubber tubing being pinched when the syringe required to be refilled. The upper catgut was finally tied and cut short when the operation was completed, and the little wound was stitched up.

There is a limit to the rate of injection on each side. One may possibly take longer to inject than the blood will remain fluid, or one may inject too rapidly for the comfort of the patient. In amputation neither of these can easily happen; but in this case the reporter believes that he committed both errors. This point of course involves the question as to how much phosphate of soda ought to be added, and as to the coagulating quality of the blood. The solution of phosphate of soda was of 5 per cent, and one part of the solution was added to three parts of blood. A slightly larger proportion is probably advisable, and was frequently used in the amputation cases.

Experience shows that, with sufficient phosphate of soda, one may occupy at least twenty or thirty minutes in injecting; and that at a slow rate the patient will experience not the least discomfort. At the same time the effect will vary with the condition of the patient. In one amputation eight ounces were injected in five minutes; in the hip sixteen ounces in about fifteen minutes, without any disturbance. The more complete and rapid depletion has been, the more quickly and largely may repletion be effected.

The reporter concludes with one other observation, viz., that the process of reinjecting the patient's own blood is incompatible with the use of spray or irrigation during the operation. For himself he is satisfied by experiment and from clinical experience that the spray does not kill micro-organisms in the air, and that in most cases the application of the germicide may safely be delayed till near the end of the operation. With pure hands and instruments, the risk from the air is trifling, and it is not worth considering when a patient is in imminent danger from hæmorrhage and collapse.

L. S. PILCHER.